

# Exhibit 6

Prepared: February 22, 2019

**University of California, San Francisco**  
**CURRICULUM VITAE**

**Name:** Mark A. Schumacher, PhD, MD

**Position:** Professor, Step 4  
 Anesthesia & Perioperative Care  
 School of Medicine

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**EDUCATION**

1977 - 1979	University of California, San Diego	B.A	Biology
1981 - 1987	University of California, San Diego (Palmer Taylor, Theodore Friedmann)	Ph.D.	Physiology & Pharmacology
1987 - 1987	University of California, San Diego (Palmer Taylor)	Fellow	Molecular Pharmacology
1987 - 1990	University of California, San Diego	Medicine	M.D.
1990 - 1990	University of California, San Diego (Tony Yaksh)	Fellow	Pain Research
1990 - 1991	Cedars-Sinai Medical Center, Los Angeles, California	Internship	Internal Medicine
1991 - 1993	University of California, San Francisco	Residency	Anesthesia
1994 - 1995	University of California, San Francisco (Jon Levine, David Julius)	Fellow	Pain Research
2003 - 2004	Blackett Laboratory - Imperial College, London UK (Nick Franks, Mervyn Maze)	Sabbatical	Biophysics Research,

**LICENSES, CERTIFICATION**

1991	Diplomat, National Board of Medical Examiners
1991	California State Medical Board License No. G072778
1995	American Board of Anesthesiology

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**PRINCIPAL POSITIONS HELD**

1993 - 1994	University of California, San Francisco	Chief Resident	Anesthesia
1994 - 1995	University of California, San Francisco	Clinical Instructor	Anesthesia
1995 - 2001	University of California, San Francisco	Assistant Professor in Residence	Anesthesia
1995 - present	University of California, San Francisco	Attending Physician	Anesthesia
2001 - 2002	University of California, San Francisco	Associate Professor in Residence	Anesthesia
2002 - 2013	University of California, San Francisco	Associate Professor	Anesthesia
2013 - present	University of California, San Francisco	Professor	Anesthesia

**OTHER POSITIONS HELD CONCURRENTLY**

1995 - 2001	University of California, San Francisco	Assistant Professor in Residence	Dept. of Oral & Maxillofacial Surgery
2001 - 2002	University of California, San Francisco	Associate Professor in Residence	Dept. of Oral & Maxillofacial Surgery
2002 - 2013	University of California, San Francisco	Associate Professor	Dept. of Oral & Maxillofacial Surgery
2003 - 2004	Imperial College London, UK	Visiting Reader	
2010 - 2015	University of California, San Francisco	Medical Director	Pain Services, UCSF Medical Center
2010 - present	University of California, San Francisco	Chief	Division of Pain Medicine, Dept. of Anesthesia and Perioperative Care
2013 - present	University of California, San Francisco	Professor	Oral & Maxillofacial Surgery

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**HONORS AND AWARDS**

1997	Radiometer/John Severinghaus Fellow in Anesthesia Research, Department of Anesthesia and Perioperative Care	University of California, San Francisco
1998	New Investigator Award	Foundation for Anesthesia Education Research (FAER)
2000	Sessler Family Anesthesia Research Award	University of California, San Francisco
2001	Frontiers in Anesthesia Research Award	International Anesthesia Research Society (IARS)

**KEYWORDS/AREAS OF INTEREST**

capsaicin receptor, chemotherapy induced peripheral neuropathy (CIPN), gene, genomics, Nerve Growth Factor, NGF, nociceptor, oxaliplatin, pain, promoter, splice variant, Transcription Factor - Sp1, Sp4, TRPV1, TRPA1, TRPM8, VR1.

**CLINICAL ACTIVITIES****CLINICAL ACTIVITIES SUMMARY**

As of January 2017, I have transitioned my clinical activity on average to 2 clinical days each week. This consists of providing approximately 8 days every month on the Anesthesia Pain Management Service, supervising residents, medical students and providing direct patient care. Previously, additional clinical activities included attending in the Moffitt Long Hospital operating rooms 1-2 days per month. Responsibilities also included in-house daytime, supervision of OR, PACU, and ICU anesthesia care plus 1 overnight E1pm/month.

**PROFESSIONAL ACTIVITIES****MEMBERSHIPS**

1991 - present	International Anesthesia Research Society
1991 - present	California Society of Anesthesiologists
1991 - present	American Society of Anesthesiologists
1995 - present	International Association for the Study of Pain
1995 - present	Society for Neuroscience
2000 - present	American Pain Society
2001 - present	Association of University Anesthesiologists (elected member)
2010 - 2012	World Institute of Pain

**SERVICE TO PROFESSIONAL ORGANIZATIONS**

1997 - 1997	IARS 71st Clinical and Scientific Congress	Co-chair, Poster Disc. Pharm
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2003 - 2003	IARS 77th Clinical and Scientific Congress	Poster Moderator-Pain
2004 - 2004	IARS 78th Clinical and Scientific Congress	Poster Moderator-Pain
2010 - 2010	American Pain Society	Review National Guidelines on Management of Postoperative Pain
2015 - 2018	California Society of Anesthesiologists	Member, Task Force on Pain
2016 - 2018	The ACTION (Analgesic, Anesthetic, and Addiction Clinical Trial Translations, Innovations, Opportunities, and Networks) public-private partnership with the FDA, the American Pain Society, and the American Academy of Pain Medicine are collaborating on the development of an acute pain taxonomy with diagnostic criteria for the major acute pain conditions.	Invited Participant
2018 - 2018	Program Committee, Napa Pain Conference 2018	
2018 - 2018	Interviewed for the American Journal of Public Health January 2019 Podcast: "Pain Management: A Crisis with No End in Sight." <a href="https://soundcloud.com/alfredomorabia/ajph-january-2019-pain-management-a-crisis-with-no-end-in-sight-english">https://soundcloud.com/alfredomorabia/ajph-january-2019-pain-management-a-crisis-with-no-end-in-sight-english</a>	Interviewee

**SERVICE TO PROFESSIONAL PUBLICATIONS**

1999 - present Ad hoc referee, Anesthesiology

2000 - 2000 Ad hoc referee, Genomics

2000 - 2000 Ad hoc referee, Brit J Pharmacol

2000 - 2006 Ad hoc referee, Molecular Pharmacol

2002 - present Ad hoc referee, Pain

2002 - 2002 Ad hoc referee, FEBS letters

2003 - 2006 Ad hoc referee, Brain Research

2004 - 2004 Ad hoc referee, British Medical Bulletin

2006 - present Ad hoc referee, Neuroreport

2008 - 2008 Ad hoc referee, J Investigative Dermatology

2008 - present Ad hoc referee, Neurosci Letters

2008 - present Ad hoc referee, J Pain

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2010 - 2010 Ad hoc referee, Stroke

2010 - 2013 Ad hoc referee, Proc Natl Acad Sci

2010 - 2012 Guest Editor, Pharmaceuticals,  
[http://www.mdpi.com/journal/pharmaceuticals/special\\_issues/ion-channels/](http://www.mdpi.com/journal/pharmaceuticals/special_issues/ion-channels/)

2018 - present Ad hoc referee, New England Journal of Medicine

2018 - present Ad hoc referee, PLoS One

**INVITED PRESENTATIONS - INTERNATIONAL**

1987	Universität Bern, Institute for Biochemistry and Molecular Biology: Bern, Switzerland, May	Invited talk
1987	University of Geneve, Department of Biochemistry: Geneve, Switzerland, May	Invited talk
2002	International Association for the Study of Pain Congress: San Diego, California, August	Poster
2004	Departement Anästhesie Universitätsspital Basel: Basel, Switzerland, February	Invited talk (2)
2004	The Queen's University of Belfast, Department of Anaesthetics: Belfast Northern Ireland, June	Elected Royal College of Anaesthetists Rank Lecturer
2004	Cellular and Molecular Neuroscience Seminar Series: Imperial College, London, UK, March	Invited talk
2004	Euroanaesthesia: Lisbon, Portugal, June	Invited congress lecture
2004	World Institute of Pain: Barcelona, Spain, September	Invited talk
2004	Division of Biophysics: Imperial College London, UK, July	Invited talk
2009	World Institute of Pain: New York, New York, March	Opening plenary lecture
2011	Zambon Research Venture, Zambon Pharmaceuticals: Milan (Bresso), Italy, November	Invited talk
2011	3rd SIMPAR (Study in Multidisciplinary Pain Research) Conference: Pavia, Italy, November	Invited Moderator, Co-Chair
2012	International Association for the Study of Pain (IASP) 14th World Congress on Pain, August (The Development of Inflammatory Thermal Hyperalgesia is Dependent on Transcription Factor Sp4)	Invited talk

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2013	5th SIMPAR (Study in Multidisciplinary Pain Research) Conference: Pavia, Italy, March (Mechanisms of Chronification of Acute into Chronic Pain)	Invited talk
2014	6th SIMPAR (Study in Multidisciplinary Pain Research) Conference: Rome, Italy, March (New Developments in Inflammation: TRPV1)	Invited talk
2015	7th SIMPAR (Study in Multidisciplinary Pain Research) Conference: Rome, Italy, March (Translational Mechanisms / Treatments of Lower Back Pain w/Radiculopathy)	Invited talk
2016	8th SIMPAR (Study in Multidisciplinary Pain Research) Conference: Rome, Italy, April (The Anticancer Antibiotic Mithramycin-A Inhibits TRPV1 Expression in Dorsal Root Ganglion Neurons)	Invited talk
2016	International Association for the Study of Pain (IASP), Yokohama, Japan (September, 2016)	Poster
2016	Wakayama University (October 2016)	Invited talk
2017	9th SIMPAR (Study in Multidisciplinary Pain Research) Conference: Florence, Italy, March	Invited talk
2018	International Anesthesia Research Society (IARS) 2018 Annual Meeting and International Science Symposium (April 28 – May 1). "Panel Session Number 204: A National Strategy to Reduce the Opioid Epidemic: A Report from the National Academies of Sciences, Engineering and Medicine"	Invited talk

**INVITED PRESENTATIONS - NATIONAL**

1995	Association of University Anesthesiologists: San Diego, California, May	Invited poster
1998	American Society of Anesthesiologists: Orlando, Florida, October	Invited poster
1999	American Pain Society: Fort Lauderdale, Florida, October	Invited poster
2000	American Society of Regional Anesthesia and Pain Medicine: Orlando, Florida, March	Invited talk
2002	International Anesthesia Research Society, Clinical and Scientific Congress: San Diego, California, April	Invited talk
2002	American Pain Society Congress: Baltimore, Maryland	Poster
2003	International Anesthesia Research Society Clinical and Scientific Congress: New Orleans, Louisiana, March	Invited talk

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2003	Association of University Anesthesiologists: Milwaukee, Wisconsin, May	Invited talk
2004	International Anesthesia Research Society, Clinical and Scientific Congress: Tampa, Florida, March	Invited talk
2005	Association of University Anesthesiologists: Baltimore, Maryland, May	Poster discussion
2005	International Anesthesia Research Society, Clinical and Scientific Congress: Honolulu, Hawaii, March	Invited talk
2006	International Anesthesia Research Society, Clinical and Scientific Congress: San Francisco, California, March	Invited talk
2007	American Society of Anesthesiologists: San Francisco, California	Poster
2007	Department of Anesthesia Grand Rounds, Emory University: Atlanta, Georgia	Invited talk
2011	Association of University Anesthesiologists: Philadelphia, Pennsylvania	Invited talk
2012	American Academy of Orthopaedic Surgeons (AAOS), National Association of Orthopaedic Nurses (NAON): San Francisco, California, February (Peripheral Nerve Catheters for Postoperative Pain Control Following Total Joint Arthroplasty)	Invited talk
2012	National Institutes of Health (NIH) Pain Consortium, Centers of Excellence in Pain Education: Bethesda, Maryland, July (Interprofessional Development of Pain Education Competencies)	Invited talk
2014	American Psychosomatic Society, Mini Medical School, March (Learning from the Past to Understand the Origins of Acute to Chronic Pain)	Invited talk
2014	7th Annual Pediatric Pain Master Class, Presented by: Children's Institute for Pain and Palliative Care (CIPPC), Department of Pain Medicine, Palliative Care and Integrative Medicine, Children's Hospitals and Clinics of Minnesota, June (Integration of Multi-Modal Pain Management Into Large Health Care Setting: Challenges, Outcomes & Lessons Learned) (TRPV1 – From Bench to Bedside: Update on Current Pain Research )	Invited talk
2014	US Department of Justice, Bay Area Prescription Drug Abuse Summit, Solutions and Impact Panel (Multimodal Pain Management Strategy), May 7, San Francisco, California.	Invited talk



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2015	California Society of Anesthesiologists Annual Meeting, April (How Does Acute Pain Turn Chronic?)	Invited talk
2016	Developing the Framework for a Comprehensive and Evidence Based ACTION-APS-AAPM Pain Taxonomy (AAAPT) for Acute Pain. The ACTION (Analgesic, Anesthetic, and Addiction Clinical Trial Translations, Innovations, Opportunities, and Networks) public-private partnership with the FDA, the American Pain Society, and the American Academy of Pain Medicine are collaborating on the development of an acute pain taxonomy with diagnostic criteria for the major acute pain conditions.	Invited talk
2017	The National Academies of Sciences, Engineering, and Medicine (NASEM) Committee on Pain Management and Regulatory Strategies to Address Prescription Opioid Abuse Consensus Report Out "Pain Management and the Opioid Epidemic: Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use" (July)	Invited Committee Member / Report Out Panel Member
2017	AAAPT Meeting. Sponsored by the ACTION (Analgesic, Anesthetic, and Addiction Clinical Trial Translations, Innovations, Opportunities, and Networks), the American Academy of Pain Medicine (AAPM), and the American Pain Society (APS). (November 3-4)	Invited talk

**INVITED PRESENTATIONS - REGIONAL AND OTHER INVITED PRESENTATIONS**

1996	UCSF Department of Anesthesia and Perioperative Care, The Changing Practice of Anesthesia Conference, Pain Management/Regional Anesthesia: San Francisco, California, September	Invited talk
1997	UCSF School of Medicine, Pain Research Group: San Francisco, California	Research seminar
1997	UCSF School of Medicine, Department of Anesthesia and Perioperative Care: San Francisco, California	Research seminar
1997	UCSF Department of Pharmacology, Graduate Program in Biomedical Sciences: San Diego, California, December	Invited talk
1998	UCI Department of Microbiology and Molecular Genetics, College of Medicine: Irvine, California, May	Invited talk
1998	UCSF School of Medicine, Department of Anesthesia and Perioperative Care: San Francisco, California	Research seminar
1999	UCSF School of Medicine, Department of Anesthesia and Perioperative Care: San Francisco, California, January	Research seminar

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1999	UCSF School of Medicine, Pain Research Group: San Francisco, California, February	Invited talk
2000	UCSF School of Medicine, Department of Anesthesia and Perioperative Care: San Francisco, California, February	Research seminar
2000	UCSF School of Medicine, Pain Research Group: San Francisco, California	Invited talk
2001	UCSF Department of Anesthesia and Perioperative Care, The Changing Practice of Anesthesia Conference, Pain Management/Regional Anesthesia: San Francisco, California, September	Invited talk
2004	UCSF School of Medicine, Department of Medicine, Grand Rounds: San Francisco, California, October	Invited talk
2005	UCSF School of Medicine, Pain Research Group: San Francisco, California, February	Invited talk
2007	UCSD Pain Group: San Diego, California	Invited talk
2007	UCSF Center for Cerebrovascular Research Seminar, June 12	Invited talk
2008	UCSF School of Medicine, Pain Research Group: San Francisco, California, May	Invited talk
2008	Anesiva: South San Francisco, California, July	Invited talk
2008	UCSD Pain Group: San Diego, California	Invited talk
2008	UCSF School of Medicine, Department of Anesthesia and Perioperative Care, Grand Rounds: San Francisco, California	Research presentation
2009	UCSF School of Medicine, Department of Anesthesia and Perioperative Care, Grand Rounds: San Francisco, California	Research presentation
2009	UCSF Department of Anesthesia and Perioperative Care, The Changing Practice of Anesthesia Conference: San Francisco, California, September	Invited talk
2009	UCSF Department of Medicine, Palliative Care Pain Lectures: San Francisco, California, October	Invited talk
2010	Venture Innovation Program (Q83) Forum on Drug Delivery: UCSF Mission Bay Campus, San Francisco, California, March	Invited talk
2010	UCSF Department of Medicine, Palliative Care Fellows Lecture: San Francisco, California	Invited talk

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2011	UCSF Pain Summit 2011, May	Course Co-Chair, Moderator, Speaker
2011	UCSF Departments of Anesthesia and Surgery, Joint Ventures in Clinical Excellence: San Francisco, California	Invited talk
2011	UCSF Department of Anesthesia and Perioperative Care, The Changing Practice of Anesthesia Conference: San Francisco, California, September	Invited talk
2011	University of California, San Diego: San Diego, California, December	Invited talk
2011	UCSF School of Medicine, Department of Anesthesia and Perioperative Care, Grand Rounds: San Francisco, California, December	Invited moderator, talk
2011	University of California, San Francisco, Patient Quality and Safety Retreat: San Francisco, California, December	Invited talk
2012	UCSF Departments of Anesthesia and Perioperative Care, Surgery and Medicine (Division of Hospital Medicine), Joint Grand Rounds, Perioperative Medicine: San Francisco, California, April	Moderator
2012	Western Anesthesia Residents' Conference (WARC): Los Angeles, California, May (Does the Capsaicin Receptor Splice Variant TRPV1var Block Activation of Sensory Neurons to Capsaicin?)	Invited talk (mentored)
2012	UCSF Department of Anesthesia and Perioperative Care, The Changing Practice of Anesthesia Conference: San Francisco, California, September (Perioperative Management of the Opioid Tolerant Patient)	Invited talk
2013	UCSF Pain Summit 2013, May	Course Chair, Moderator, Speaker
2013	Western Anesthesia Residents' Conference (WARC): Albuquerque, New Mexico, May (Determining a nociceptive transcriptome by "Deep Sequencing" (RNA-Seq) analysis of sensory ganglia from Sp4 +/- heterozygote mice)	Invited talk (mentored)
2013	UCSF Department of Anesthesia and Perioperative Care, Pain Medicine Grand Rounds, November	Moderator
2014	UCSF Department of Anesthesia and Perioperative Care, The Changing Practice of Anesthesia Conference: San Francisco, California, September (Securing Hospital Approval for Ketamine Use on the Wards)	Invited talk

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2014	Western Anesthesia Residents' Conference (WARC): Los Angeles, California, May (Benefits Beyond Pain Control: Multimodal Analgesia Associated with Reduced Hospital Length of Stay)	Invited talk (mentored)
2015	UCSF Department of Anesthesia and Perioperative Care, Pain Medicine Grand Rounds, February	Moderator
2015	UCSF Pain Research Group Lecture, February (Chronification of Pain: The Role of Sp1-like Transcription Factors)	Invited talk
2015	Pain Fellows Lecture (Bench to Bedside)	Invited talk
2015	UCSF Pain Summit, May	Course Chair, Moderator, Speaker
2016	UCSF Department of Surgery Grand Rounds (The Surgeon's Role in Prescribing Narcotics and the Management of Chronic Pain)	Invited talk
2017	Opioid Prescribing Practices Special Grand Rounds (April 19)	Invited talk
2017	UCSF Department of Anesthesia and Perioperative Care Grand Rounds: Pain	Moderator
2017	Napa Pain Conference. (August 18-20) NASEM Presentation: Pain Management and the Opioid Epidemic - Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use.	Invited talk
2017	California Society of Interventional Pain Physicians (CASIPP) 8th Annual Meeting. NASEM Presentation: Pain Management and the Opioid Epidemic - Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use. (September 15-17)	Invited talk
2018	Napa Pain Conference. (August 16-19)	Invited Panel Talk

**GOVERNMENT AND OTHER PROFESSIONAL SERVICE**

2002 - 2002	BioStar University of California (1)	Grant Review: Ad Hoc
2003 - 2004	National Science Foundation (2)	Grant Review: Ad Hoc
2009 - 2009	National Institute of Health (4)	Grant Review RFA Panel 23
2012 - 2013	Defense Medical Research and Development Program (DMRDP), Department of Defense (DOD)	Grant Reviewer and Member

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2016 - 2018	National Academies of Sciences, Engineering, and Medicine, Committee on Pain Management and Regulatory Strategies to Address Prescription Opioid Abuse *Consensus Report, Published July 2017: Pain Management and the Opioid Epidemic - Balancing Societal and Individual Benefits and Risks of Prescription Opioid Abuse" *July 12, 2017: Briefing with the FDA *July 12, 2017: Briefing with the staff of House Energy and Commerce Committee, Subcommittee on Health *July 13, 2017: Consensus Report Public Release Webinar	Member
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## UNIVERSITY AND PUBLIC SERVICE

### SERVICE ACTIVITIES SUMMARY

**Division of Pain Medicine:** Beginning in 2010, I undertook the formation of a Division of Pain Medicine ([pain.ucsf.edu](http://pain.ucsf.edu)).

**UCSF Health:** Through my contributions on the interdisciplinary Pain Committee and the Pharmacy and Therapeutics (P&T) Committee, I have provided content expertise and leadership on a wide range of analgesic practice and policy concerns. This includes in depth contributions of a special medical staff committee on opioid prescribing practices that resulted in policy changes, a report out at the level of the Chancellor and presenting at a special Grand Rounds for all medical staff on opioid prescribing practices.

**National:** I served on the National Academies of Sciences, Engineering, and Medicine, Committee on Pain Management and Regulatory Strategies to Address Prescription Opioid Abuse and authored several key chapters in our Consensus Report, Published July 2017: "Pain Management and the Opioid Epidemic - Balancing Societal and Individual Benefits and Risks of Prescription Opioid Abuse." I was one of four members selected by the chair of the NASEM committee to participate in dissemination of the report by webinar; to FDA leadership and congressional staff committees as well as a number of media outlets.

### UCSF CAMPUSWIDE

1997 - 1997	USP Drug Information Writing Contest	Judge
1998 - 1998	Office of the Vice Chancellor, Ad Hoc Committee for Appraisal of Achievement and Promise	Chair
2006 - 2006	Office of the Vice Chancellor, Ad Hoc Committee for Appraisal of Achievement and Promise	Member
2012 - present	Pharmacy and Therapeutics Committee	Member
2015 - 2015	Stewardship Review, Department Chair, UCSF Office of the Vice Provost	Member
2016 - 2016	Ad-hoc Committee, UCSF Medical Staff Services. Faculty professionalism, review of opioid prescribing practices.	Member
2018 - present	UCSF Opioid Task Force	Member

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**SCHOOL OF MEDICINE**

2009 - present	Pathway to Medical Center Discovery in Molecular Medicine	Faculty Member
2010 - 2010	President of Medical Staff - Ad Hoc Committee: Faculty Professionalism	Member
2010 - 2015	Pain Management Services UCSF Medical Center	Medical Director
2010 - 2015	Pain Management Committee	Chair
2010 - 2013	Continuous Pulse Oximetry Project-12L	Physician Champion
2010 - 2013	PCA Ad Hoc Safety Committee	Physician Champion
2010 - 2013	Remote Centralized Monitoring committee	Member
2011 - 2011	UCSF Pain Summit, May 2011	Co-Director
2013 - 2015	UCSF Pain Summits, May 2013 & May 2015	Director
2018 - 2018	Interviewed for Episode 13 of "The Spark: Medical Education for Curious Minds." <a href="https://soundcloud.com/the-spark-for-medical-education/the-spark-episode-13-treatment-of-chronic-pain">https://soundcloud.com/the-spark-for-medical-education/the-spark-episode-13-treatment-of-chronic-pain</a>	Interviewee

**DEPARTMENTAL SERVICE**

1998 - 1998	UCSF Department of Anesthesia and Perioperative Care	Review and Promotions Committee
1999 - 1999	UCSF Department of Anesthesia and Perioperative Care	Junior Faculty Meetings, Junior Faculty Coordinator
2001 - 2001	UCSF Department of Anesthesia and Perioperative Care	Review and Promotions Committee
2006 - 2015	UCSF Department of Anesthesia and Perioperative Care	Scientific Merit Review Committee
2009 - 2009	UCSF Department of Anesthesia and Perioperative Care	Patient Clinical Study Oversight Committee, Ad Hoc Member

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2010 - 2015	UCSF Department of Anesthesia and Perioperative Care	Director of Acute Pain Service, Moffitt/Long Hospital
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2010 - present	UCSF Department of Anesthesia and Perioperative Care	Chief, Division of Pain Medicine
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# **COMMUNITY AND PUBLIC SERVICE**

1995 - 2005	United States Pharmacopeia - USP (Elected Position)	Anesthesiology Expert Advisory Panel Member: (Reviewed and critiqued anesthesia and pain management drug and therapeutic information Published as USP DI. Active for 10 years
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2004 - present	Faculty of 1000 Medicine - Anesthesiology & Pain Management (Appointed)	North American Section Head, Pain-Basic Science: Oversight, faculty selection and review of high-impact research summaries
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2007 - 2007	Redwood High School: Larkspur, California	Science Fair Judge
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2010 - 2017	Gnu Foundation, Kenya	Physician Champion: Linking UCSF to Kilimambogo Mission Hospital, Kenya
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2018 - 2018	SF City Impact - Health and Wellness Center. Volunteer physician and health educator for economically disadvantaged patient population in the SF City Impact Health and Wellness Center located in the Tenderloin neighborhood.	Volunteer physician
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## RESEARCH AND CREATIVE ACTIVITIES

### RESEARCH AND CREATIVE ACTIVITIES SUMMARY

**Chemotherapy Induced Peripheral Neuropathy (CIPN):** Successful treatment of patients suffering from a wide range of cancers often require the administration of chemotherapeutic agents that are associated with the development of acute and chronic painful conditions. Often referred to as, Chemotherapy Induced Peripheral Neuropathy, CIPN encompasses a wide range of clinical symptoms and pathophysiologic states. The pain associated with platinum-based anticancer agents, is perhaps one of the most recognized and well-studied but also resistant to effective treatments. In fact, no effective therapies exist to prevent or reverse the pain that can limit life-saving anticancer treatments or that degrades the quality of life of cancer survivors. In collaboration with Drs. Miaskowski and Levine, our laboratory is advancing study of non-opioid strategies to block / reverse painful CIPN. I am also collaborating on clinical studies focused on phenotyping and genomic biomarkers of CIPN.

**Endovanilloid / Endocannabinoids and TRPV1:** In collaboration with Dr. Judith Hellman, in collaboration to identify and further characterize the effects of the endovanilloid / endocannabinoid, N-arachidonoyl dopamine (NADA) and the minor cannabinoids activation of TRPV1 under conditions of tissue injury and sepsis.

**Nociceptive Gene Regulation:** Identification of receptors / ion channels that respond to noxious stimuli has been at the forefront of a new understanding of peripheral pain transduction. A seminal finding was the isolation of the capsaicin receptor (also known as VR1 and now termed TRPV1) that is essential for inflammatory pain and hyperalgesia. Having played a critical role in the initial isolation and characterization of TRPV1 (Nature '97), my laboratory has been pioneering a new understanding of the transcriptional regulation of nociceptive genes. More specifically, how inflammation and nerve injury drive persistent pain states (Acute to Chronic) through the expression of TRPV1 and other nociceptive channels.

### RESEARCH AWARDS - CURRENT

1. T32 GM08440	Faculty, Mentor; Pain and Addiction Program Administrator	Judith Hellman (PI)
NIH	06/2017	present
Basic Science Anesthesia Research Training Grant		
Provide oversight and research training opportunities in the area of peripheral pain transduction. Active Fellow: Man-Cheung Lee		
2.	Principal Investigator	Schumacher (PI)
UCSF Department of Anesthesia and Perioperative Care	07/01/2018	06/30/2019
Anesthesia Department Research Support Award (Mechanisms and Blockade of Platinum-based Painful Neuropathy)	\$ 80,000 direct/yr 1	\$ 80,000 total



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**RESEARCH AWARDS - Pending**

1. P01 CA233703 Co-Investigator Miaskowski, Levine (PI)

NIH/NCI (Pending)

Chronic Neurotoxicity Associated With \$ 5,128,982  
Chemotherapy: Risk Factors and Mechanisms direct/yr 1

The major goals of this project are to: 1) determine the relationships between chronic CIPN and audiovestibular neurotoxicity associated with platinum and taxane CTX; 2) identify common and distinct phenotypic and genomic risk factors for chronic CIPN and audiovestibular neurotoxicity; 3) determine the relationships between stress and chronic CIPN and audiovestibular neurotoxicity; 4) determine the impact of chronic CIPN and audiovestibular neurotoxicity on important patient outcomes (e.g., falls, symptoms, QOL); and 5) use preclinical models to evaluate the role of nociceptor neuroplasticity and the impact of stress on the development of chronic CIPN.

**RESEARCH AWARDS - PAST**

1. Principal Investigator Schumacher (PI)  
UCSF Research Evaluation UCSF Research Evaluation 1997 1999  
Characterization of NGF Regulated Proteins Expressed by \$ 15,000 \$ 15,000 total  
Primary Sensory Neurons direct/yr 1

2. Principal Investigator Schumacher (PI)  
Radiometer / John W. Severinghaus Fellow in Anesthesia 1997 1999  
Research - UCSF  
Molecular Mechanisms of Nerve Growth Factor (NGF) \$ 50,000 \$ 100,000  
Mediated Hyperalgesia and Pain direct/yr 1 total

3. R01 NS38737 Principal Investigator Scumacher (PI)  
NIH R01 NIH/NINDS 1997 2007  
Capsaicin Receptor Subtypes in Pain Transduction (\*No-cost \$ 101,234 \$ 1,079,702  
extension 2006-2007) direct/yr 1 total

4. Principal Investigator Schumacher (PI)

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	Foundation for Anesthesia Education Research New Investigator Award	1998	2000
	The Role of Capsaicin Receptors in Nociception	\$ 70,000 direct/yr 1	\$ 140,000 total
5.	Principal Investigator		Schumacher (PI)
	UCSF E. Ackerman Foundation for Research in Medicine	2001	2003
	Shared Equipment AProposal: Cryostat	\$ 15000 direct/yr 1	\$ 15000 total
6.	Principal Investigator		Schumacher (PI)
	Frontiers in Anesthesia Research Award International Anesthesia Research Society (IARS)	2001	2006
	Stretch-Inactivated Channels in Pain Transduction	\$ 100,000 direct/yr 1	\$ 500,000 total
7.	T32 - PACCTR Co-Mentor		
	NIH (UCSF)	2006	2007
	Pathways to Careers in Clinical and Translational Research	\$ Fellow's salary direct/yr 1	
8.	Principal Investigator		Schumacher (PI)
	UCSF Springer H. Mem. Foundation	2007	2008
	REAC Hardship	\$ 25,000 direct/yr 1	\$ 25,000 total
9.	Mentor		
	Foundation for Anesthesia Education and Research	2008	2008
	Medical Student Anesthesia Research Fellowship	\$ student stipend direct/yr 1	

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10.	Principal Investigator	Schumacher (PI)
National Headache Foundation Research Grant	2008	2009
Regulation of capsaicin receptor (TRPV1) expression in meningeal sensory neurons under inflammatory conditions.	\$ 16,000 direct/yr 1	\$ 16,000 total
11.	Principal Investigator	Schumacher (PI)
UCSF / SOM Bridge Funding Grant	2008	2009
Capsaicin Receptor Subtypes in Pain Transduction	\$ 73,750 direct/yr 1	\$ 73,750 total
12. R01DK046285-09	Co-Investigator	
NIH	2008	2013
Neural Regulation of Pancreatitis	\$ 250,000 direct/yr 1	
13. R01 NS38737-08	Principal Investigator	
NIH	2009	2013
Capsaicin Receptor subtypes in Pain Transduction	\$ 218,750 direct/yr 1	\$ 1,120,481 total
14. 3R01NS038737-09S1	Principle Investigator	Schumacher (PI)
NIH	2010	2010
Supplement: Optogenetics and TRPV1	\$ 77,250 direct/yr 1	\$ 77,250 total
15.	Principal Investigator	Schumacher (PI)
Office of Naval Research/UCSD	2010	2011
Pain Management by an Endogenous Antihyperalgesic	\$ 88,186 direct/yr 1	\$ 88,186 total

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16. T32 GM08440	Co Investigator		Young (PI)
Basic Science Anesthesia Research Training Grant		2011	2016
17. N/A	Principal Investigator / Program Manager		
NIH / NIDA		07/10/2012	09/30/2013
UCSF Center of Excellence in Pain Education		\$ 98,647 direct/yr 1	\$ 98,647 total
18.	Principal Investigator		
UCSF Department of Anesthesia and Perioperative Care		04/01/2013	06/30/2013
Anesthesia Department Research Support Award Bridge Funding		\$ 25,000 direct/yr 1	
19.	Principal Investigator		
UCSF Department of Anesthesia and Perioperative Care		11/12/2014	06/30/2015
Anesthesia Department Research Support Award Bridge Funding		\$ 59,490 direct/yr 1	
20. IRB Number: 13-12177	Principal Investigator		
		05/01/2015	04/30/2016
Clinical Investigation. Study Title: Effect of a multimodal analgesic protocol on post-operative pain, opioid consumption and readiness for discharge in adult patients undergoing primary knee or hip replacement.			
21.	Principal Investigator		
UCSF Department of Anesthesia and Perioperative Care		07/01/2015	06/30/2016
Anesthesia Department Research Support Award Bridge Funding (Transcriptional Mechanisms and Blockade of Platinum Based Painful Neuropathy)		\$ 80,000 direct/yr 1	

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22. Contract Number: HHSN271201500052C NIH / NIDA NIH Pain Consortium Centers of Excellence in Pain Education	Principal Investigator/Project Manager   	07/15/2015 \$ 77,867 direct/yr 1	Schumacher (PI) 07/14/2016 \$ 77,867 total
23.  UCSF Department of Anesthesia and Perioperative Care Anesthesia Department Research Support Award	Principal Investigator   	01/01/2016 \$ 80,000 direct/yr 1	Schumacher (PI) 06/30/2017 \$ 80,000 total
24.  Anesthesia Department Research Support Award		07/01/2017	Schumacher (PI) 06/30/2018 \$ 44,436 total
25. T32 GM08440  NIH  Provide oversight and research training opportunities in the area of peripheral pain transduction.	Faculty, Mentor; Pain and Addiction Program Administrator	7/2012	Judith Hellman (PI) 6/2017
26.  UCSF Department of Anesthesia and Perioperative Care Research Award (Transcriptional Mechanisms and Blockade of Platinum-based Painful Neuropathy)	Principal Investigator   	07/01/2017 \$ 80,000 direct/yr 1	Schumacher (PI) 06/30/2018 \$ 80,000 total
27.  UCSF Department of Anesthesia and Perioperative Care Supplemental Research Award (Transcriptional Mechanisms and Blockade of Platinum-based Painful Neuropathy)	Principal Investigator   	07/01/2017 \$ 43,436 direct/yr 1	Schumacher (PI) 06/30/2018 \$ 43,436 total

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## PEER REVIEWED PUBLICATIONS

1. **Schumacher MA**, Alksne JF. Mechanisms of whole blood-induced cerebral arterial contraction. *Neurosurgery*.1981 Sep;9(3):275-82.
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3. **Schumacher M**, Camp S, Maulet Y, Newton M, MacPhee-Quigley K, Taylor S, Friedmann T, Taylor P. Primary structure of Torpedo californica acetylcholinesterase deduced from its cDNA sequence. *Nature*.1986 Jan 30-Feb 5;319(6052):407-9.
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13. Xue Q, Yu Y, Trilk SL, Jong BE, **Schumacher MA**. The genomic organization of the gene encoding the vanilloid receptor: evidence for multiple splice variants. *Genomics*. 2001 Aug;76(1-3):14-20.

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14. Ständer S, Moormann C, **Schumacher M**, Buddenkotte J, Artuc M, Shpacovitch V, Brzoska T, Lippert U, Henz BM, Luger TA, Metze D, Steinhoff M. Expression of vanilloid receptor subtype 1 in cutaneous sensory nerve fibers, mast cells, and epithelial cells of appendage structures. *Exp Dermatol*. 2004 Mar;13(3):129-39.
15. Eilers H, **Schumacher MA**. Opioid-induced respiratory depression: are 5-HT<sub>4</sub>a receptor agonists the cure? *Mol Interv*. 2004 Aug;4(4):197-9.
16. Eilers H, Trilk SL, Lee SY, Xue Q, Jong BE, Moff I, Levine JD, **Schumacher MA**. Isolation of an mRNA binding protein homologue that is expressed in nociceptors. *Eur J Neurosci*. 2004 Nov;20(9):2283-93.
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18. Eilers H, Lee SY, Hau CW, Logvinova A, **Schumacher MA**. The rat vanilloid receptor splice variant VR.5'sv blocks TRPV1 activation. *Neuroreport*. 2007 Jul 2;18(10):969-73.
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26. **Schumacher MA**. Pain Management for the Obese Sleep Apnea Patient: Insights for ICU Practitioners. *ICU Director*. 2012;3:80-84.
27. **Schumacher MA**. Back Pain and the Mineralocorticoid Receptor: Is There a Connection? *Anesthesiology*. 2012 Nov;117(5):951-2.
28. Wilhelmsen K, Khakpour S, Tran A, Sheehan K, **Schumacher M**, Xu F, Hellman J. The Endocannabinoid/Endovanilloid N-Arachidonoyl Dopamine (NADA) and Synthetic

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31. Guan Z, Hellman J and **Schumacher M**. Contemporary views on inflammatory pain mechanisms: TRPping over innate and microglial pathways. *F1000Res*. 2016 Sep 30;5. pii: F1000 Faculty Rev-2425. eCollection 2016.
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## REVIEW ARTICLES

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2. **Schumacher M**, Xue Q. New insights into the role of the capsaicin receptor (TRPV1) in inflammatory pain. *Cell Science* 3:1-6, 2007.
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<http://members.csahq.org/blog/2016/09/20/prescription-opioid-epidemic-challenges-and-opportunities-california-pain-physicians>
5. De Pinto M, Pasvankas G, Yu X, Poree L, Gritzner S, **Schumacher M**. Pain Management at UCSF. Serving Bay Area Patients. San Francisco Marin Medicine. *Journal of the San Francisco Marin Medical Society*. 2017 June 90(5): 24-25.

## BOOKS AND CHAPTERS

1. Taylor P, **Schumacher M**, Gibney G, Maulet Y, and Quigley K. Molecular studies of acetylcholinesterase structure. In: Sellin LC, Libelins R, and Thesleff S, eds. *Fernstein Symposium Series*, L.C. Vol. 13. Amsterdam: Elsevier; 1989.
2. Way WL, Fields HL, and **Schumacher MA**. Opioid Analgesics and Antagonists. In: Katzung B, ed. *Basic and Clinical Pharmacology*, 8th Edition. The McGraw-Hill Companies; 2001.
3. **Schumacher MA** and Eilers H. Sensory Processing: Peripheral Nociceptors. In: Evers A, Maze M, eds. *Anesthetic Pharmacology: Physiologic Principles and Clinical Practice. A Companion to Miller's Anesthesia*. Philadelphia, PA: Churchill Livingston/Elsevier; 2004:173-185.
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10. **Schumacher MA**, Basbaum AI, and Naidu R. Opioid Analgesics & Antagonists. In: Katzung BG, Trevor AJ, eds. *Basic and Clinical Pharmacology*. 13th ed. McGraw-Hill Education; 2015.
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## **PATENTS ISSUED OR PENDING**

1. UCSF INVENTION DISCLOSURE Thoracotomy Pain Management Strips UCSF Case # SF2009-015
2. Patent application UCSF-435 WO, "Methods and Composition for the Treatment of Pain"
3. UCSF INVENTION DISCLOSURE: Treatment and Prevention of Chemotherapy-Induced Peripheral Neuropathy (CIPN) and Neuropathic Pain. UCSF Case #2016-083

## **OTHER CREATIVE ACTIVITIES**

1. Division of Pain Medicine Website (<http://pain.ucsf.edu/#>) Live April 2014
2. Anesthesia Pain Case Presentation: The Opioid Tolerant Patient
3. Anesthesia Resident Board Review handout (17 pages) updated annually. Topic: Pain
4. Anesthesia 110 - Acute and Chronic Pain (slide presentation)
5. 2010 Pain Medicine: UCSF Department of Anesthesia Internet Wiki Page: Content and organization - Board Review Questions - Pain Novel Pharmacotherapy: The old becomes 'new' (slide presentation)
6. NIH Center of Excellence in Pain Education Case Module (Interprofessional Management of Acute to Chronic Leg Pain)
7. NIH Center of Excellence in Pain Education Case Module (Pain Management in an Adult with PTSD and Opioid Use Disorder in the Perioperative Setting)
8. Pain: New Insights and New (and Old) Treatments, "Back to the Future" of Pain Medicine. UC TV. <https://www.youtube.com/watch?v=oPRn1Pk5OCo>. <http://www.uctv.tv>.
9. Mark Schumacher interviewed for:  
Cooney, R. All Hands on Deck-Addressing the Nation's Opioid Epidemic. The Lancet United States of Health Blog. July 27, 2017. <http://usa.thelancet.com/blog/2017-07-27-all-hands-deck—addressing-nation's-opioid-epidemic>
10. Mark Schumacher interviewed for:  
Healy, M. The U.S. should rethink its entire approach to painkillers and the patients addicted to them, panel urges. Los Angeles Times. July 13, 2017.  
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